CLAIMS

1. An on-signal calibration system for a transmitter that
    generates in-phase (I) and quadrature phase (Q) values
    and that converts, modulates and combines the I and Q
    values into a radio frequency (RF) output signal for
    transmission, said calibration system comprising:

    a detector that senses the RF output signal and that
        provides a detection signal indicative thereof;

    a sampler that samples said detection signal and that
        provides digital samples;

    a selector that selects from among said digital
        samples that correspond to predetermined ranges
        of the I and Q values;

    an imbalance estimator that determines at least one
        imbalance estimate based on selected digital
        samples; and

    an IQ corrector that corrects said I and Q values
        using said at least one imbalance estimate.

2. The calibration system of claim 1, wherein said
    detector comprises an envelope detector.

3. The calibration system of claim 1, wherein said
    sampler comprises an analog to digital converter
    (ADC).

4.   The calibration system of claim 1, further comprising:

said selector selecting digital samples that
    correspond with first and second selection boxes
    symmetrically located on either side of an I/Q
    origin on an I-axis of a plot of said I and Q
    values;

said selector selecting digital samples that
    correspond with third and fourth selection boxes
    symmetrically located on either side of said I/Q
    origin on a Q-axis;

wherein said imbalance estimator determines an I
    channel DC offset using selected digital samples
    of said first and second selection boxes and
    determined a Q channel DC offset using selected
    digital samples of said third and fourth
    selection boxes.

5.   The calibration system of claim 1, further comprising:

said selector selecting digital samples that
    correspond with first and second selection boxes
    symmetrically located on either side of an I/Q
    origin on an I-axis of a plot of said I and Q
    values;

said selector selecting digital samples that
    correspond with third and fourth selection boxes
    symmetrically located on either side of said I/Q
    origin on a Q-axis; and

wherein said imbalance estimator determines an
amplitude imbalance estimate using selected
digital samples.

6.   The calibration system of claim 1, further comprising:

said selector selecting digital samples correspond
with first and second selection boxes
symmetrically located on either side of an I/Q
origin on a 45 degree axis of a plot of said I
and Q values;

said selector selecting digital samples that
correspond with third and fourth selection boxes
symmetrically located on either side of said I/Q
origin on a 135 degree axis; and

wherein said imbalance estimator determines a phase
imbalance estimate using selected digital
samples.

7.   The calibration system of claim 1, further comprising:

a power circuit that determines digital power values
using said digital samples and the I and Q
values;

said selector selecting from among said digital power
values; and

said imbalance estimator determining said at least one
imbalance estimate based on a ratio of selected
digital power values.

8.   The calibration system of claim 1, further comprising:

a magnitude circuit that determines digital magnitude
     values using said digital samples and the I and Q
     values;

said selector selecting from among said digital
     magnitude values; and

said imbalance estimator determining said at least one
     imbalance estimate based on a ratio of selected
     magnitude values.

9.   A transmitter, comprising:

a baseband processor providing I and Q signals,
     comprising:

     an I/Q corrector that corrects said I and Q
          signals using at least one imbalance metric;

     a hit detector that generates gate signals
          indicative of predetermined ranges of said I
          and Q signals;

     a selector, coupled to said hit detector, that
          selects portions of a characteristic signal
          based on said gate signals; and

an imbalance estimator, coupled to said selector
and said imbalance estimator, that uses
selected portions of said characteristic
signal to determine said at least one
imbalance metric;

a radio frequency (RF) quadrature modulator that
coverts said I and Q signals into an RF output
signal; and

an output signal detector that senses a characteristic
of said RF output signal indicative of said at
least one imbalance and that outputs said
characteristic signal.

10. The transmitter of claim 9, wherein said output signal
detector comprises an envelope detector and wherein
said characteristic signal comprises an envelope
signal.

11. The transmitter of claim 9, wherein said baseband
processor further comprises:

a core that generates I and Q digital values;

a sampler that samples said characteristic signal and
that provides digital samples;

said hit detector providing said gate signals
indicative of a plurality of symmetric selection
boxes at predetermined phases of said I and Q
digital values; and

said selector selecting from among said digital
      samples based on said gate signals.

12.   The transmitter of claim 11, wherein:

said imbalance estimator determines an I DC offset
      based on digital samples corresponding with
      selection boxes at 0 and 180 degrees; and

wherein said imbalance estimator determines a Q DC
      offset based on digital samples corresponding to
      selection boxes at 90 and 270 degrees.

13.   The transmitter of claim 11, wherein said imbalance
      estimator determines an amplitude imbalance based on
      digital samples corresponding to selection boxes at 0,
      90, 180 and 270 degrees.

14.   The transmitter of claim 11, wherein said imbalance
      estimator determines a phase imbalance based on
      digital samples corresponding to selection boxes at
      45, -135, 135 and 315 degrees.

15.   The transmitter of claim 11, wherein said baseband
      processor further comprises:

said imbalance estimator providing at least one
      imbalance error value using said selected digital
      samples; and

an integrator, coupled to said imbalance estimator and said I/Q corrector, that integrates each said at least one imbalance error value to provide said at least one imbalance metric.

16. The transmitter of claim 11, wherein said baseband processor further comprises:

a power circuit, coupled to said core and said sampler, that determines and provides digital power values based on said I and Q digital values and said digital samples;

said selector selecting from among said digital power values and sorting selected digital power values into first and second sets of digital power values; and

said imbalance estimator using said first and second sets of digital power values to determine said at least one imbalance metric.

17. The transmitter of claim 16, wherein said baseband processor further comprises a first average block that averages said first set of digital power values and a second average block that averages said second set of digital power values.

18. The transmitter of claim 16, wherein said baseband processor further comprises:

said selector providing said first set of digital
power values as I power values corresponding to 0
and 180 degree selection boxes and said second
set of digital power values as Q power values
corresponding to 90 and 270 degree selection
boxes; and

said imbalance estimator calculating a ratio of said Q
and I power values for providing an amplitude
imbalance metric.

19. The transmitter of claim 16, further comprising:

said selector providing said first set of digital
power values as first phase power values
corresponding to 45 and -135 degree selection
boxes and said second set of digital power values
as second phase power values corresponding to 135
and 315 degree selection boxes; and

said imbalance estimator calculating a differential of
said first and second phase power values for
providing a phase imbalance metric.

20. The transmitter of claim 11, wherein said baseband
processor further comprises:

a magnitude circuit, coupled to said core and said
sampler, that determines and provides digital
magnitude values based on said I and Q digital
values and said digital samples; and

said selector selecting from among said digital
    magnitude values and sorting selected digital
    magnitude values into first and second sets of
    digital magnitude values; and

said imbalance estimator using said first and second
    sets of digital magnitude values to determine
    said at least one imbalance metric.

21. The transmitter of claim 11, wherein said baseband
     processor further comprises a digital delay block that
     receives said I and Q digital values and that provides
     delayed I and Q digital values.

22. The transmitter of claim 21, wherein said baseband
     processor further comprises a fractional delay device
     that delays said digital samples to align timing with
     said delayed I and Q digital values.

23. A method of on-signal calibration of a radio frequency
     (RF) quadrature modulator which modulates in-phase (I)
     and quadrature phase (Q) signals incorporating I and Q
     digital values into an RF output signal, comprising:

detecting the RF output signal and providing a
    detection signal;

sampling the detection signal and providing digital
    samples;

selecting from among the digital samples corresponding
    to predetermined ranges of the I and Q digital
    values;

estimating at least one imbalance metric using
   selected digital samples; and

calibrating the I and Q signals using the at least one
   imbalance metric.

24.   The method of claim 23, wherein said detecting the RF
      output signal and providing a detection signal
      comprises detecting an envelope of the RF output
      signal and providing an envelope signal.

25.   The method of claim 23, wherein:

      said selecting comprising selecting digital samples
         corresponding to first, second, third and fourth
         symmetrical selection boxes at 0, 90, 180 and 270
         degree phase, respectively; and

      wherein said estimating comprising estimating an I
         channel DC offset using the digital samples of
         the first and third symmetrical selection boxes,
         and estimating a Q channel DC offset using the
         digital samples of the second and fourth
         symmetrical selection boxes.

26.   The method of claim 23, wherein:

      said selecting comprising selecting digital samples
         corresponding to first, second, third and fourth
         symmetrical selection boxes at 0, 90, 180 and 270
         degree phase, respectively; and

wherein said estimating comprising estimating an
amplitude imbalance using the selected digital
samples.

27. The method of claim 23, wherein:

said selecting comprising selecting digital samples
corresponding to first, second, third and fourth
symmetrical selection boxes at 45, 135, 225 and
315 degree phase, respectively; and

wherein said estimating comprising estimating a phase
imbalance using the selected digital samples.

28. The method of claim 23, wherein:

said selecting comprising selecting digital samples
corresponding to first, second, third, fourth,
fifth, sixth, seventh and eighth symmetrical
selection boxes at 0, 45, 90, 135, 180, 225, 270
and 315 degree phase, respectively; and

wherein said estimating comprising determining an I
channel DC offset error using selected digital
samples of the first and fifth selection boxes,
determining a Q channel DC offset error using
selected digital samples of the third and seventh
selection boxes, determining an amplitude
imbalance error using selected digital samples of
the first, third, fifth and seventh selection
boxes, and determining a phase imbalance error
using selected digital samples of the second,
fourth, sixth and eighth selection boxes.

29. The method of claim 28, further comprising integrating
the I channel DC offset error, the Q channel DC offset
error, the amplitude imbalance error and the phase
imbalance error over time using corresponding loop
multipliers.

30. The method of claim 23, further comprising:

determining power values using the digital samples and
the I and Q digital values.

said selecting comprising selecting power values
corresponding to symmetrical selection boxes at
0, 90, 180 and 270 phase; and

said estimating comprising estimating an amplitude
imbalance using the selected power values.

31. The method of claim 23, further comprising:

determining power values using the digital samples and
   the I and Q digital values;

said selecting comprising selecting power values
   corresponding to symmetrical selection boxes at
   45, 135, 225 and 315 phase; and

said estimating comprising estimating a phase
   imbalance using the selected power values.

32.   The method of claim 23, further comprising:

determining magnitude values using the digital samples
   and the I and Q digital values.

said selecting comprising selecting magnitude values
   corresponding to symmetrical selection boxes at
   0, 90, 180 and 270 phase; and

said estimating comprising estimating an amplitude
   imbalance using the selected magnitude values.